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Guidelines for Monitoring Populations of Neotropical Migratory Birds on National Forests System Lands

Monitoring Task Group Report


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Monitoring Task Group Report:
GUIDELINES FOR MONITORING POPULATIONS OF NEOTROPICAL MIGRATORY BIRDS ON NATIONAL FOREST SYSTEM LANDS

by
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Executive Summary

In May 1990, the National Fish and Wildlife Foundation launched the Neotropical MigratoryBird (NTMB) Conservation Program, a domestic and international initiative for the conservation of NTMBs. The USDA Forest Service has participated in the NTMB Conservation Program from its inception in 1990. The NTMB program within the Forest Service focuses on supporting activities in three main emphasis areas, including establishing cooperative monitoring programs on National Forest System (NFS) lands. This document contains standards and guidelines for establishing a scheme for monitoring bird population trends and demographics on NFS lands.

Monitoring birds on NFS lands is important for three primary reasons. First, a coordinated monitoring effort on all NFS lands will contribute a significant amount of information for evaluating local, regional, continental, and, potentially, global population trends of species. Second, monitoring populations and habitats of vertebrate species is mandated by laws and regulations governing activities on NFS lands. Finally, monitoring population demographics (and associated environmental factors) is essential to identifying both the potential threats to population viability and the corrective management actions to be undertaken.

The monitoring standards and guidelines are prefaced by a list of goals for monitoring birds on NFS lands. The goals reflect information needs within the agency and those identified in the monitoring needs assessment (Butcher 1992) developed by the monitoring working group of Partners in Flight—Aves de las Americas: (1) Build an understanding of the influence of habitat changes resulting from Forest Service management activities on NTMBs; (2) Provide insights into the temporal dynamics and trends of local and regional populations of target NTMB species; (3) Provide some clues as to the cause(s) of trends; and (4) Contribute to national and international Partners in Flight monitoring efforts.

A hierarchical monitoring framework was developed to define priorities for various types of information needs. The hierarchical structure is meant to encourage each national forest or grassland to participate in at least one and hopefully multiple levels of the framework. The framework consists of three levels of monitoring effort: (1) Level 1 entails monitoring population trends; (2) Level 2 evaluates habitat relationships or management impacts; and (3) Level 3 monitors species' demographics and associated environmental factors. The monitoring framework outlined in this document was motivated by concerns for NTMBs, but it will serve to monitor resident bird species, as well as neotropical migratory bird species. As a result, the NTMB program has the potential to provide the vehicle by which we can obtain valuable information on the status of a variety of bird species and bird communities on NFS lands.

Monitoring standards that applied to all levels of the framework were developed. Standards are important to ensure that monitoring efforts conducted within each level of the framework are comparable across spatial and temporal scales. Standards were developed regarding the priority of seasons for monitoring, the need for monitoring proposals for all monitoring activities, the need for trigger points in all monitoring efforts to serve as signals for needed change in management approaches, and the need for consistency over time through the use of permanent monitoring stations. In addition, standards were outlined for the use of point counts, the basis for level 1 monitoring. Point count standards addressed count duration, distance bands used during counts, the need for multiple observers, and the importance of knowing the sample size needed to answer the monitoring questions being posed.

A more detailed description of each level of monitoring is given below.

Level 1 monitoring is the most basic of monitoring efforts. Level 1 monitoring includes two distinct efforts: (1) Cooperating with the U.S. Fish and Wildlife Service to ensure that States, regions, and (possibly) physiographic provinces each have enough Breeding Bird Survey (BBS) routes surveyed annually to characterize population trends at each scale; and (2) Monitoring population trends of NTMBs at a forest or regional level via off-road and roadside point counts. Level 1 monitoring provides population trend data for a national forest with a minimum amount of effort and funding but it will not yield information on interpretation of trends, since sampling is not stratified by environmental parameters. Standards and guidelines for conducting level 1 monitoring are outlined.

Level 2 monitoring is aimed at gathering information on habitat specific population trends, habitat relationships, and landscape effects on populations. Level 2 monitoring requires additional time and effort over and above level 1 monitoring. Individual treatments need to be adequately sampled and replicated across a region or a forest. Standards and guidelines for conducting level 2 monitoring are outlined.

Level 3 monitoring obtains information on species demographics. Monitoring the relative abundance of species over time is typically inadequate to address cause and effect relationships of management activities or habitat quality. Demographic data will provide information needed to assess population viability and for interpreting population trends. Two generalized procedures are currently being evaluated for their ability to yield demographic data: constant-effort mist-net procedures and nest search and monitoring procedures. Both approaches have inherent advantages and limitations that are discussed and should be considered before use.

Additional information may also be desired for the breeding and nonbreeding season that goes beyond the objectives or the abilities of the methods employed in level 1-3 monitoring. Additional objectives are discussed, such as conducting inventories, obtaining indices of habitat quality, obtaining information on species not effectively monitored by techniques in level 1-3 monitoring, and monitoring during the nonbreeding season.

Involvement in data collection, analysis, storage and exchange associated with the monitoring program for NTMBs extends across all levels within NFS and Research. In particular, all levels of the agency will benefit from standardized data acquisition and data-handling methods. A scheme for assigning roles and responsibilities to each level of the agency and to Research is described. Basically, the Chief is responsible for providing direction on national priorities and standards, facilitating nation wide analyses, and conducting national and regional program reviews. Regional foresters are responsible for playing a major role in providing regional direction (e.g., developing regional monitoring plans), providing training and technical services for forests (e.g., data centers), and ensuring quality work is performed. Forest Supervisors are responsible for implementing the regional monitoring plans. The specific responsibilities of forest supervisors will vary among regions, according to the regional monitoring plans. And finally, participation of Research is essential to the success of the NTMB monitoring program. It is crucial that station directors maintain a high degree of interaction and coordination with regions.

I. Acknowledgements

Numerous individuals contributed to the inception, evolution, and completion of this document. Foremost recognition goes to Teri Raml (formerly the Neotropical Migratory Bird Coordinator in the Wildlife and Fisheries staff, Washington, DC), who recognized the need for national monitoring guidelines within the Forest Service and commissioned to have this document created through a cooperative effort between NFS and Research. Teri reviewed and commented on all drafts and provided positive support throughout the effort.

Thanks also go out to all those who reviewed drafts, including, Jared Verner (Project Leader, Pacific Southwest Station), Dick Hutto (Professor of Biology, University of Montana), Joelle Buffa (Wildlife Program Leader, Pacific Southwest Region), and Oscar Stuart (Wildlife Staff Officer, Francis and Sumter National Forests). Finally, thanks to Debbie Pressman for supporting and tracking the document through the Washington Office for finalization and distribution.

II. Introduction

Recent analyses of regional bird censuses (Robbins, et al., 1989a, b) indicate that population reductions of many NTMBs are occurring across North America (Wilcove and Whitcomb 1983, Terborgh 1989, James, et al., 1992, Witham and Hunter 1992). However, trends vary among species and geographic areas, indicating that more comprehensive and detailed monitoring is needed to better understand the problem(s) (Finch 1991). Because NTMBs comprise up to 70 percent of the breeding birds in forested, woodland, and grassland habitats across the nation, their decline poses a serious threat to the diversity of avifaunas in North America (Terborgh 1992, Block in press). Two primary factors have been suggested to explain the population declines: forest fragmentation on the breeding grounds and deforestation of wintering habitats (Morse 1980, Terborgh 1989, Askins, et al., 1990). Clearly, a comprehensive and cooperative national and international program is needed to monitor and conserve populations of migrant avian species.

In May 1990, the National Fish and Wildlife Foundation launched "Partners in Flight - Aves de las Americas, the NTMB Conservation Program," which is a domestic and international initiative for the conservation of NTMBs. Partners in Flight is designed to focus monitoring, research, and habitat management at national and international scales. The Forest Service administers a large proportion of forested and grassland habitats in the U.S. and is an active member of the program. Consequently, the Forest Service has an important role in the conservation of NTMB populations.

A cadre of standardized protocols for a variety of avian survey and monitoring methods now exist. Standardized roadside point counts have been employed for the BBS since 1965 (Robbins, et al., 1989b). Other standardized protocols for obtaining population trend and demographic data have recently been developed, and they are all described in some detail in the handbook, *Field Methods for Monitoring Landbirds* (Ralph, et al., in press b). The application of many of these standardized protocols has only recently been undertaken, and much effort is currently being directed at testing the applicability of these methods to specific research and monitoring questions.

This document outlines goals, standards, and guidelines for monitoring bird population trends and demographics on NFS lands. The document was created by a task group consisting of representatives from regions, stations, and the Partners In Flight monitoring working group. The guidelines in this document need not be restricted to NFS lands. Other land managers are encouraged to consider these guidelines in the development of their avian monitoring schemes to facilitate consistency across jurisdictional boundaries.

III. Monitoring Neotropical Migratory Birds on National Forest System Lands

A. Why Monitor Species?

Monitoring birds on NFS lands is important for three primary reasons. First, a coordinated monitoring effort on all NFS lands will contribute a significant amount of information for evaluating local, regional, continental, and, potentially, global population trends of species. Second, monitoring populations and habitat of vertebrate species is mandated by laws and regulations governing activities on NFS lands. Finally, monitoring population demographics (and associated environmental factors) is essential to identifying both the potential threats to population viability and the corrective management actions to be undertaken.

The Endangered Species Act (ESA) (1973, as amended) states that all Federal departments and agencies shall seek to conserve endangered and threatened species and shall provide a means whereby ecosystems upon which endangered and threatened species depend may be conserved. The National Forest Management Act (NFMA) builds on ESA by stating that, "Fish and wildlife habitat shall be managed to maintain viable populations of existing native and desired non-native vertebrate species in the planning area." In compliance with ESA and NFMA, Forest Service policy states that it will manage habitats for all existing native and desired non-native plants, fish, and wildlife species to maintain viable populations of such species and to avoid actions that may cause a species to become threatened or endangered. In addition, Forest Service policy states that viable populations will be maintained in habitats distributed throughout their geographic range on NFS lands.

The Forest Service typically monitors trends in habitat as a surrogate for the status of associated wildlife species in compliance with ESA, NFMA, and Forest Service policy. Rarely has the Forest Service monitored animal species. However, it is typically insufficient to monitor trends in habitat and assume that population levels are proportional to habitat quality (Van Horne 1983). Many factors other than habitat affect populations, such as human disturbance, predation, competition, prey abundance, parasitism, adverse weather, disease, and, for migratory species the status of wintering habitat. The number and distribution of reproductive individuals and their productivity and survival are key measures of an area's ability to support viable populations. These population parameters cannot be measured directly from habitat data but must be determined through demographic monitoring and research. Only through such monitoring and research can we quantitatively assess population parameters to ensure that our land management activities are in compliance with governing laws and regulations.

B. Why Should the Forest Service Monitor Neotropical Migratory Birds?

The Forest Service administers a significant portion of the undeveloped lands and some of the least fragmented habitats in the U.S. Management of NFS lands will have a profound affect on the quality and quantity of breeding habitat available to NTMBs in the U.S. NTMBs contribute substantially to the species richness of bird communities and to the biological diversity of most ecosystems. Further declines in breeding populations of NTMBs would significantly affect the diversity of bird communities in North America and may negatively affect many ecosystem functions. Monitoring populations and habitats of NTMBs will provide important information on the sustainability of natural ecological systems, including the maintenance and enhancement of biological diversity.

The primary focus of the Partners In Flight Program is the conservation of NTMBs. The monitoring framework outlined in this document was motivated by concerns for NTMBs, but it will serve to monitor resident bird species, as well as NTMB species. As a result, the NTMB program within the Forest Service has the potential to provide the vehicle by which we can obtain valuable information on the status of a variety of bird species and bird communities on NFS lands. Bird communities provide a valuable barometer to the condition of ecosystems (Dickson, et al., 1979, Morrison 1986). Monitoring NTMBs will contribute to our understanding of ecosystem structure and function, and thereby further our understanding of the role of NTMBs in ecosystems.

Monitoring species is central to evaluating the success of forest plan implementation. NFMA Reg. 36 CFR 219.12(k) requires that forest plans include three types of monitoring: (1) Implementation monitoring to determine if a plan or project has been implemented as prescribed; (2) Effectiveness monitoring to determine if a particular action produced the expected results; and (3) Validation monitoring to determine if a model or a set of assumptions hold true in a particular area. The monitoring framework described here for birds will contribute greatly to validation monitoring for land management planning by improving our understanding of ecosystem structure, function, and interdependence.

NFMA directs the Forest Service to identify forest management indicator species (MIS) and associated monitoring plans in their land management plans. The regulations state that, "Population trends of the management indicator species will be monitored and relationships to habitat changes determined." (36 CFR 219.19 a6). MIS are intended to reflect the effects of management activities on all animal species and communities. However, the concept of using one or a few species to reflect a larger assemblage of species has been investigated and questioned by many researchers, and most investigations do not lend credence to the concept (Szaro and Balda 1982, Verner 1983, Mannan, et al., 1984, Verner 1984, Block, et al., 1986, Morrison 1986, Szaro 1986, Thomas and Verner 1986, Verner 1986, Block, et al., 1987a, Landres, et al., 1988). The monitoring framework described here monitors most bird species, essentially negating the need for avian MIS and greatly strengthening the ability of the Forest Service to estimate the status of habitat quality for birds.

C. Monitoring at Multiple Spatial and Temporal Scales

Patterns in spatial and temporal variability of population trends and demographics can provide valuable insights into potential causal factors. The framework described here defines a monitoring approach that would yield data on spatial and temporal patterns. Tracking population and demographic trends at the forest level would provide information on variation in trends across a region or some other geographical/ecological unit. Data from individual forests can be combined and examined along with other regional data (such as BBS data) to determine larger scale trends. Trends at the regional and national levels provide an important context for evaluating local or forest-level trends. Examining variation in trend data across a region can be an important tool for understanding metapopulation dynamics and identifying population sources and sinks, which is important information for species conservation (Howe, et al., 1991).

D. Adapative Managementt

Traditional resource management has been based on the premise that basic research leads to an understanding of the factors affecting resources within the managed ecological system. This understanding then forms the basis for analysis of alternative land management scenarios, ultimately leading to a recommended plan that is "optimal" according to some specified management objectives. This management paradigm fails to: (1) Account for the temporal variability that is characteristic of natural resources and that often occurs at temporal scales well beyond timeframes considered in land management planning; (2) Recognize that factors important in understanding resource interactions may yet be identified; and (3) Account for the inevitable occurrence of stochastic events. Temporal variation in resources, the absence of complete knowledge of all important factors affecting resource interactions, and the likelihood of stochastic events translate into great uncertainty when attempting to predict resource response to management.

As an alternative to the traditional management perspective, managers and researchers can (and often do) acknowledge the fact that we cannot accurately predict the outcome of many of our resource management actions and policies. Many management actions and policies are essentially "perturbation experiments" that frequently have uncertain outcomes (Walters and Holling 1990). Adaptive management is the process of monitoring and evaluating the results of these "experiments" and using the information to adjust current and future management actions (Holling 1978, Walters 1986). Resource management plans should be dynamic, evolving over time rather than being implemented unchanged over a planning period. Under the adaptive management approach, information from monitoring activities is used continually to evaluate and modify resource management activities.

Goals for monitoring on NFS lands are listed below. The goals reflect information needs within the agency and those identified in the Partners In Flight monitoring work group's needs assessment (Butcher 1992) for Partners in Flight: (1) Build an understanding of the influence of habitat changes resulting from Forest Service management activities on NTMBs; (2) Provide insights into the temporal dynamics and trends of local and regional populations of selected NTMB species; (3) Provide some clues as to the cause(s) of trends; and (4) Contribute to national and international Partners in Flight monitoring efforts.

A hierarchical monitoring framework is proposed that defines priorities for various types of information needs. The hierarchical structure is meant to encourage each national forest or grassland to participate in at least one, and hopefully multiple, levels of the framework. The framework is structured to allow for variation in the availability of funds and personnel among units and over time by outlining options that require varying levels of effort. The options range from extensive surveys of population trends requiring a minimum investment of time and funding to intensive monitoring of population demographics. The hierarchical framework defines monitoring options that build on one another, and they are presented in order of priority. The framework consists of three levels of monitoring: (1) Level 1 entails monitoring population trends; (2) Level 2 evaluates habitat relationships or management impacts; (3) Level 3 monitors species' demographics and associated environmental factors.

IV. Monitoring Standards and Framework

The field methods are not discussed in detail in this document because they are already well described in other documents. Each monitoring level involves some use of point counts, usually in combination with other survey techniques. Point count surveys represent a reasonable compromise between counting efficiency and quality of data (Verner 1985). Point count surveys should follow the standards developed at the Point Count Workshop held in Patuxent, Maryland, on November 6-7, 1991 (Ralph, et al., in press a). The proceedings of the Point Count Workshop (Ralph, et al., in press a) and the Field Methods for Monitoring Landbirds (Ralph, et al., in press b) can currently be obtained in draft form from C. John Ralph, (Redwood Science Laboratory, 1700 Bayview Dr., Arcata, CA 95521). Monitoring standards for demographic data are not as well established, but the two primary procedures recommended for level 3 monitoring are described in some detail in Ralph, et al., (in press b), DeSante (1991), and Martin and Geupel (in press). A draft of Martin and Geupel (in press) can be obtained from Geoff Geupel at the Point Reyes Bird Observatory (4990 Shoreline Hwy, Stinson Beach, CA 94970). The following recommendations are compatible with these standards, and therefore we will not address all details of survey methods. However, some aspects of implementation that are critical to standardizing the use of methods are emphasized.

A. Monitoring Standards for All Levels in the Framework

The following standards are important to ensuring that monitoring efforts at each level are comparable across geographic locations and over time. Monitoring activities at each level in the hierarchy should comply with set standards listed below.

1. ***Season of Monitoring.*** Breeding birds should be the first priority of NTMB monitoring because breeding problems have been the most implicated North American cause of population declines (for review see Askins, et al., 1990). However, monitoring during migration and wintering may be of particular interest to forests that provide critical habitats for NTMBs during these periods. Monitoring during fall migration can provide information on productivity of a species on a national scale as birds from the more northern and inaccessible forests move to the south. If gathering information on all land bird species (i.e., residents and migrants) is a priority, then some portion of the breeding and non-breeding seasons should be monitored, since limiting factors for resident birds may occur at either time of the year.

2. ***Monitoring Proposals.*** Monitoring proposals should be prepared and then undergo review by a research scientist (or other qualified individual) and a biometrician for sound design and statistical validity before monitoring begins.

3. ***Trigger Points.*** Trigger points are the link between monitoring and adaptive management. They identify when, where, and what management actions will be taken in response to resource conditions. All monitoring efforts should have trigger points identified which quantify one or more resource conditions that, if reached, will launch some described research or management action. Trigger points should be quantified and measurable so there is no question when it is time to take action. It is also important that trigger points reflect small changes in resource conditions, because once major changes in resource conditions occur it may be impossible to stop or

reverse any negative effects. Examples of some resource conditions that indicate a needed change in management and for which quantified trigger points could be developed include:

(a) Population declines or increases of species that are already of concern (e.g., threatened, endangered, sensitive, proposed for listing);

(b) Population declines of groups of species that have a common environmental link;

(c) Population declines of species associated with rare habitats;

(d) A decline in productivity or survivorship of species of concern, species groups with common environmental links, or species associated with rare habitats;

(e) Population increases of avian and non-avian species that prey upon, compete with, or parasitize NTMBs;

(f) Population increases in exotics and residents that are commensal with humans;

(g) Increased rates of parasitism, predation, or reproductive failure;

(h) Degradation or loss of important or rare habitats;

(i) Significant increases in human-induced fragmentation; and

(j) Widespread applications of pesticides.

4. ***Permanent Stations.*** All monitoring stations should be marked permanently and the same stations used each year.

B. Monitoring Standards for all Point Counts

1. ***Count Duration.*** All point counts should be at least 5 minutes in duration. The first 3 minutes of each count should be indicated on data sheets so the data can be compared to BBS data. Any counts conducted for longer than 5 minutes will mark the 5 minute point in the count so the first 5 minutes can be extracted from the data.

2. ***Distance Bands.*** The point count standards call for recording all birds seen and heard inside and outside a 50 m radius of the counting station. The area within 50 m is considered an area where the detectability of species is similar enough to enable the comparison of abundance among species (Ralph, et al., in press b). Outside 50 m, the detectability of species varies too greatly to allow for among-species comparisons. In narrow habitats, such as riparian areas, a smaller radius band of perhaps 25 m may be added to the 50 m radius band to identify birds occurring within the habitat of interest.

3. ***Multiple Observers.*** Point counts associated with a monitoring effort should be conducted by multiple observers (Verner and Milne 1989). The number of observers required should be determined using local or habitat specific information on potential observer bias. Habitats vary in the relative difficulty

they present in accurately counting birds. Habitats with dense vegetation (which obscures vision), high species richness, or high bird abundance all provide challenges to observers that increase the likelihood that observations will vary between observers. Skill levels will also vary between observers, depending upon the criteria used to select observers.

If local data on biases associated with habitats and observers are not available, they should be pursued through research. In lieu of local data, a minimum of three highly skilled observers should be used on each monitoring effort each year (Verner and Milne 1989). The assignment of observers to points or transects should attempt to spread the biases of each observer equally across all environmental conditions being monitored. If points are only counted once per season, three observers can survey different stations across all areas so that any biases are compensated for by combining the data across observers. If points are counted more than once per season, then each count should be conducted by a different observer. Using three observers each year will help to average out individual biases within a year and reduce the likelihood that between-year differences are attributable to the biases of an individual observer.

4. *Sample Sizes.* The number of counting stations required to meet forest or regional objectives should be evaluated with pilot or first year data to determine sample sizes that will yield the desired level of confidence. If preliminary data are unavailable to estimate minimum sample sizes, local researchers should be consulted to estimate an appropriate sample size. If data are unavailable, at least the minimum number of counting stations suggested should be established for each level of the hierarchy. As soon as preliminary data become available, minimum sample size requirements should be calculated. A biometrician should be consulted when calculating minimum sample sizes or when making inferences about minimum sample sizes using local data sources.

C. Level 1 Monitoring

Objective: To determine population presence/absence or abundance trends.

Level 1 monitoring is the most basic of monitoring efforts. It is important that level 1 monitoring be implemented consistently across all forests, and all forests should implement at least level 1 monitoring. Level 1 monitoring should be achieved on all NFS lands within the next 3 years.

Level 1 monitoring includes two distinct efforts: (1) Cooperating with U.S. Fish and Wildlife Service to ensure that the Forest Service is doing all it can to see that States, regions, and physiographic provinces each have enough BBS routes surveyed annually to characterize population trends; and (2) Monitoring population trends of NTMBs at a forest level via off-road and roadside point counts.

BBS routes are continent-wide, permanent roadside point counts coordinated by the U.S. Fish and Wildlife Service. BBS data are important contributions to national and regional trends. The Forest Service needs to cooperate with U.S. Fish and

Wildlife Service to ensure that regions, States, and (if possible) physiographic provinces each have enough routes surveyed annually to characterize population trends. A minimum of approximately 14 routes per geographic area are required to achieve an acceptable level of precision for population trends (Sam Droege, U.S. Fish and Wildlife Service, Office of Migratory Bird Management, Laurel, MD 20708). BBS methodology is well documented (Robbins, et al., 1989b). NFS could contribute by proposing new BBS routes, recruiting volunteers to survey the routes, and providing support services for volunteers.

The second component of level 1 monitoring provides population trend data for a forest. Monitoring population trends consists of collecting data on the presence/absence and abundance of species in specific locations over time. Presence/absence data appears to be highly correlated with abundance (Bart and Klosiewski 1989) and provides a more easily obtainable parameter by which to assess trends over time. Counting stations established for level 1 monitoring are not stratified by environmental parameters (e.g., vegetation types). As a result, level 1 monitoring provides information on the trend of NTMB populations on a forest with the minimum level of effort and expenditure. However, it will not yield information on the interpretation of trends since sampling is not stratified by environmental parameters. Stratifying by environmental parameters would require larger sample sizes and may not be achievable on all forests.

If landbird monitoring is already taking place at the regional or forest level, a biometrician should be consulted before changing any activities. Current activities may already be meeting level 1 monitoring needs or, alternatively, level 1 monitoring may be easily achieved by making minor adjustments or augmentations to existing efforts. Existing monitoring efforts may already be accumulating valuable long-term data sets, and it is important to maintain the integrity of existing efforts as much as possible. Guidelines for implementing level 1 monitoring are outlined below.

1. ***Establishing Counting Stations.*** Counting stations should be located on transects which are distributed randomly across the forest to obtain a representative sample of habitats and ecotones. Counting stations should be systematically spaced along the transects (see Ralph, et al., in press a), and each transect should be short enough to be surveyed in one morning. Transects could be stratified by geographic region (e.g., districts) to get adequate dispersion of transects across a forest. Some counting stations could be located along roads to maximize counting efficiency, but the roads should be no larger than tertiary or secondary roads (Hutto, et al., in prep). Care should be taken when interpreting the data from roadside counts because roads may not access a representative sample of conditions on a forest (Hutto, et al., in prep). A combination of roadside and off-road counting stations is probably the best approach.

2. ***Sample Size Requirements.*** If preliminary or local data are unavailable on a forest to estimate minimum sample sizes, 200 counting stations per forest should be considered the minimum sample size for the first sampling season (Verner and Kie 1988, Thompson and Schwalbach in press). On large or very diverse forests, a larger initial sample size is recommended. After the first sample season, the data must be analyzed to determine the sample size required for precise estimates of changes in presence/absence or abundance at counting stations for the least detectable target species

(i.e., species for which monitoring data is desired or needed). After the second year, sample sizes should be reevaluated to determine the minimum sample size needed to detect differences between years. A biometrician should be consulted at each step in the design and analysis process.

3. ***Count Duration and Visitation Frequency.*** Counting stations should be visited once during the breeding season for a 5-minute count, recording all birds detected around the station. Other objectives may favor longer counts or repeat visits, but the recommended number of visits and count length is limited for level 1 monitoring to increase the number of stations that can be surveyed per unit effort. Increasing the number of counting stations will provide greater statistical power to detect trends (Zar 1984). This protocol best achieves the primary objective of monitoring trends over a large geographic area, although other measures may be compromised (e.g., accurate estimates of the species that occur at a given station).

4. ***Observers.*** Each observer should be randomly assigned one-third of the transects to be visited.

5. ***Habitat Measurements.*** At a minimum, vegetation at each counting station should be classified to plant association or sub-type, preferably using an ecological classification system that is consistently applied throughout the region. Ralph, et al., (in press b) describes a relevé method that is useful in determining plant associations. Habitat classifications schemes should be identified and described in the regional monitoring plans. Habitat measurements are not critical in level 1 monitoring because the objective and sample design are not intended to yield information on detailed habitat associations or potential causes of trends.

D. Level 2 Monitoring

Objective: To relate species' abundances or population trends to land use practices or habitat characteristics.

Level 2 monitoring is aimed at gathering information on habitat specific population trends, habitat relationships, and landscape effects on populations. There is a broad range of applications for level 2 monitoring. Level 2 monitoring could be designed to track habitat specific population trends, or it could be used to describe habitat relationships of one or more bird species. A range of habitat conditions could be monitored, including conditions ranging from "natural" to a variety of managed conditions. Level 2 monitoring can also be designed to look at trends and habitat relationships at a landscape scale by addressing questions of abundance and population trends over time in relation to habitat juxtaposition, patch size, and overall landscape condition.

Level 2 monitoring requires additional time and effort over and above level 1 monitoring. Rather than sampling abundances of bird species across a forest, individual vegetation treatments or habitats need to be adequately sampled and replicated (Box, et al., 1978) across a region or forest. Monitoring habitat specific population trends will also yield data on habitat association, which can be of direct and immediate use at the forest level. Level 2 monitoring can be accomplished on a regional, multi-forest, or forest level, depending upon funding and support within the region. Guidelines for implementing level 2 monitoring are outlined below.

1. ***Establishing Counting Stations.*** Counting stations should be randomly located throughout as many representative areas as possible for each habitat condition.

2. ***Sample Size.*** A number of considerations exist when estimating sample size needs for level 2 monitoring.

   (a) Describing the species associated with a particular habitat requires that adequate sample sizes are achieved *within* each habitat.

   (b) Minimum sample sizes should be calculated based on preliminary data and desired levels of confidence.

   (c) If preliminary or locally applicable data are unavailable to estimate sample size, an absolute minimum of 30 counting stations should be established within each habitat condition for the first sample season. Thirty counting stations per replicate sample requires that the 30 stations must be randomly located throughout each habitat condition or treatment. After the first sample season, the data should be analyzed to determine the minimum sample size required to achieve the monitoring objectives. It is highly likely that much larger sample sizes will be needed to meet desired levels of confidence for target species (Fleiss 1981).

3. ***Count Duration and Visitation Frequency.*** A number of considerations exist when determining count duration and visitation frequency for level 2 monitoring.

   (a) Count duration and visitation frequency affect the number of counting stations that can be sampled per unit effort, with the ultimate goal being to provide an accurate estimate of the presence/absence or abundance trends of bird species occurring in specific habitat conditions.

   (b) Some researchers believe that each counting station should be visited a minimum of three times during the breeding season to maximize the probability of detecting a species occurring in a given habitat condition. Other researchers believe that the best method of maximizing the probability of detecting a species occurring in a given habitat condition is to maximize the number of counting stations within each habitat and visit each station only once per breeding season.

   (c) If local data are unavailable, a pilot sample should be developed with the help of a biometrician.

   (d) Species accumulation curves should be calculated for each counting station to determine how much time is required to detect the majority of species at each point and if the greatest variability occurs between points or at a point over the counting period.

4. *Habitat Measurements.* Considerations for habitat measurements in level 2 monitoring are listed below.

   (a) Habitat characteristics should be quantified at and around each counting station.

   (b) Each monitoring project should carefully consider the type of habitat information and the level of precision required to address the specific questions being posed.

   (c) At a minimum, habitat variables such as plant species composition, canopy closure, vegetation structure, slope, aspect, and elevation should be quantified using standardized techniques. The relevé method described in Ralph, et al., (in press b) describes methods of estimating many of these vegetation characteristics.

   (d) If monitoring objectives require the vegetation characteristics be quantified precisely, standardized measurement techniques should be used in lieu of visual estimates (James and Shugart 1970, Block, et al., 1987b). Standards for habitat measurements and associated protocols should be described in regional monitoring plans (see section V.B.).

E. Level 3 Monitoring

Objective: To monitor species' demographics.

Monitoring the relative abundance of a species is typically inadequate to address cause and effect relationships of management activities or habitat quality (Van Horne 1983, Hobbs and Hanley 1990). Species abundance does not reflect factors contributing to a species fitness, such as reproductive success or survival of the young once they leave the nest. Southwood (1977) and Van Horne (1983) present convincing arguments for including estimates of reproductive and survival rates in assessments of management effects on species. These data are particularly important for evaluating population viability.

Demographic data consist of two components: (1) Survivorship, the probability of survival from birth to age x; and (2) Reproduction, the expected number of female offspring for each female of age x per unit time. The monitoring methods described here provide proxies to one or both components of demographic data. Two generalized procedures are currently being evaluated for their ability to yield demographic data: constant-effort mist netting and nest search and monitoring. Both approaches have inherent advantages and limitations that should be considered before use.

Constant-effort mist netting (and associated point counts) provides estimates of the following population and demographic parameters: (1) Adult population size and post-fledging productivity from data on the number and proportion of young and adult birds captured; (2) Adult population size, adult survivorship, and recruitment into the adult population from capture-recapture data on the adults; and (3) Adult population size from intensive point-count data collected in the immediate vicinity of the mist-netting stations. A network of at least 40 stations across a multistate region are required to produce estimates of adult population size and adult

survivorship with sufficient precision to provide critical information on the demographic parameters and trends of 10-20 target species. Sufficient precision is defined as a coefficient of variation (CV) of 20 percent for the mid-year annual estimate or a CV of approximately 5 percent for the mean annual estimate in a 10-year study.

The major advantage of constant-effort mist netting is that it samples the demographics of populations over a fairly large area. The area sampled by one station fluctuates during the breeding season. Early in the season, one station samples only a few acres in the immediate vicinity of the nets. By mid-July, birds from several hundred hectares are being caught. By the end of the breeding season in late August, depending upon the species, birds from a few thousand hectares to half the continent can be caught. Constant-effort mist-netting data appears to be most useful in providing large-scale trend data that are well complemented by habitat or area-specific monitoring to contribute to a monitoring scheme that can serve as a feedback mechanism for land management on a local scale in a timely fashion.

Nest search and monitoring offer an alternative method of obtaining demographic data. They provide information on productivity via nest success in addition to information on habitat associations. The strengths of nest search and monitoring are that: (1) Productivity data can be directly associated with habitat conditions; and (2) Factors affecting productivity, such as predation and brood parasitism, can be quantified. The nest search procedure cannot provide information on survivorship, and it is labor intensive, so study areas are typically small and few in number. Because nest searches are time intensive, a subset of species should be identified and the majority of effort should be spent obtaining an adequate sample size for key species versus looking for any nest in an area regardless of the species (in which case there may not be enough nests of any species for analysis). At least 20 nests per species must be located to estimate productivity (Martin and Geupel in press).

Most level 3 monitoring efforts typically should be conducted in conjunction with level 1 and 2 efforts because together they provide a more complete picture of the dynamics of the ecosystem. Additional methods of characterizing population demographics and ways to obtain other valuable data (e.g., the genetic diversity within a population) need to be explored as large-scale monitoring tools to provide information where existing methods fall short.

V. Augmenting Level 1, 2, or 3 Monitoring

Additional information may also be desired for the breeding season and non-breeding season that goes beyond the objectives achieved in monitoring levels 1-3. This section of the document identifies some important information not provided by level 1-3 monitoring and discusses some ideas on how to augment level 1-3 monitoring to yield more information.

A. Inventories

1. ***Baseline Inventories.*** Baseline species inventories provide a snapshot in time of what species occur where. Inventories require that specific areas or habitats be adequately sampled to determine the presenc/absence and possibly the abundance of a species. Inventories are valuable in that they may detect the presence of species of special interest or concern that may not be detected during monitoring. Inventories can be directed at habitats, species, or both. However, inventories do not provide the type of information needed to estimate the effects of management or to develop

management plans. The number of counting stations required for level 1 or 2 monitoring generally will be inadequate to yield a detailed forest inventory. Inventories can be achieved by augmenting level 1 or 2 monitoring efforts (i.e., establishing more counting stations) to sample all areas of a habitat type or all habitats in an area. If multiple habitats are of interest, stations could be added such that habitats are sampled in proportion to their occurrence, or sampling could be weighted toward rarer habitats.

Wherever possible, the location of existing inventory efforts should be considered before establishing additional independent stations. Time, money, and effort possibly could be saved by teaming up with other inventory efforts. For example, forest inventory and analysis (FIA) plots or ecosystem classification plots offer valuable habitat information already described. However, it is important to carefully evaluate the methods and assumptions used in designing existing inventory efforts to ensure they are compatible with the bird inventory efforts. A biometrician should be consulted before finalizing station placements.

2. ***"Big Survey Days."*** Big Survey Days use volunteers to conduct 1-day inventories when more comprehensive inventories are not possible. Groups of volunteers conduct point counts 1 day each year to obtain an inventory of an area of interest (e.g., a project area or district). Big survey days can be repeated monthly or quarterly to add a seasonal dimension to the inventory. As a side note, Big Survey Days also give amateur bird watchers an opportunity to become informed about the Partners In Flight program and become involved in its implementation.

3. ***Checklists.*** Checklists can be a useful method of conducting inventories when other inventory methods are not feasible. A checklist is simply a list of all birds occurring in a location during each season, with a space next to each species to record the number of individuals sighted. The checklist can include information on when species are typically present in the area and their general abundance. Checklists can be used to informally inventory areas. For example, members of the public can use the checklist to record the location of their outing and the species and number of individuals detected. Checklists could be postage paid, so they can be mailed back to the unit office at no charge to the user. This scheme has been successfully employed by some States (Temple and Cary 1990), but it has not been widely used by the Forest Service to date. At first checklists maybe crude, but they become more complete over time by revising them based on data collected by the users.

B. Indices of Habitat Quality

Level 1 and 2 monitoring yields no information on nest success and productivity of birds within a habitat. Information on nest success and productivity, as well as abundance, may be required to fully assess habitat quality (Fretwell and Lucas 1970, Fagan 1988). If level 3 monitoring is not feasible, some options exist to augment level 1 or 2 monitoring to obtain an index of habitat quality.

Breeding status surveys are an informal method of gathering some information about how birds are using a habitat. The breeding activity of a bird is commonly referred to as its breeding status, such as whether or not an individual is paired,

nesting, or has successfully fledged young. Point counts can be supplemented with information on the breeding status of bird species in the vicinity of the counting station. General information can be gained about the use and value of an area or habitat condition for one or more bird species. However, the applicability of such anecdotal information is limited, as the data are not well standardized and provide only generalizations about use.

Breeding status is determined by following individual birds and recording their breeding activity, if discernible. Minimal effort is required to determine the breeding status of one or two species in an area of interest. Additional effort can be invested to obtain breeding status information for more species. A series of codes established for Breeding Bird Atlases can be used to document the breeding status of birds (appendix A). The probability of confirming the breeding status of a species increases with the amount and timing of effort expended. For comparisons of data among species and/or years, the amount and timing of effort expended must be roughly equivalent among species and years. Tracking the number of hours spent searching an area or focusing on specific species could be noted each year. The first year, observers could get a feeling for how much time is generally required to find evidence of species nesting and establish an acceptable range of levels of effort per unit area per year.

C. Non-breeding Season Monitoring

A variety of valuable information on NTMBs can be obtained by monitoring during the non-breeding season. In spring and fall, monitoring can help identify migration routes and important stopover sites. Mist netting is particularly useful for obtaining these data. Monitoring during spring and fall migration can also provide a relative index to the survivorship and productivity, respectively, of species from year to year within large geographic areas.

Perhaps more importantly, non-breeding season monitoring can yield important information on the role of local and regional habitat in providing necessary requirements for birds during the critical and stressful periods of migration, post-breeding dispersal, and winter. The quantity and quality of habitats used during these periods have the potential to limit populations of NTMB species as much or more than habitats used during the breeding or wintering seasons. Monitoring resident and wintering species during the winter can provide valuable information on what may be limiting resident populations during the winter and how the limited resource(s) may affect NTMBs during the breeding season. Mist netting and point counts are useful monitoring techniques for gathering all of these data. Hussell (1981) provides some additional guidance on how to monitor bird populations during migration.

D. Species Not Monitored by Level 1-3 Methods

Level 1 and 2 monitoring employ the use of point count methodologies to obtain information on bird population trends and habitat associations. However, many bird species, such as raptors, nocturnal birds, habitat specialists, and species with small breeding ranges, are not surveyed well or at all by point counts. An extensive review of the literature on effective monitoring techniques for these types of species was not conducted; however, we provide some suggestions below. References exist for how to survey and monitor a multitude of vertebrate species, such as reviews in Cooperrider, et al., (1986), the *Needs Assessment: Monitoring Neotropical Migratory Birds* (Butcher 1992), and Ralph and Scott (1981).

Raptors are probably the group of species of greatest concern that are not adequately monitored by levels 1-3 as described. In general, surveying for raptors presents a number of challenges. Most raptors are wide ranging, emit infrequent vocalizations, and occur in low densities. These characteristics, coupled with the nocturnal habits of owls, make counting raptors time consuming and expensive. Koskimies and Vaisanen (1991) describe an effective method for monitoring multiple raptor species using a grid scheme. Other methods of monitoring raptors include nest searches by foot and air, and aerial searches for population centers. For a detailed review of the most common methods of detecting and counting raptors see Fuller and Mosher (1987), Kochert (1986), and Haapala and Saurola (1991).

Nocturnal birds present special difficulties. While standard protocols exist for some nocturnal species, such as the spotted owl (Forsman 1983), other important species, such as nighthawks can be missed by most methods. Some nocturnal species can be monitored using existing counting stations by visiting points and using vocal imitations or recordings to elicit vocal responses. Nocturnal surveys can be conducted with a minimum of additional effort by surveying only a subset of existing counting stations and/or limiting the number of nocturnal species to be monitored.

Monitoring habitat specialists also has its difficulties. Habitat specialists are often associated with special habitat components such as ponds, logs, or other patchily distributed resources. Habitat specialists are difficult to monitor because they often have irregular distributions, and they typically do not emit regular vocalizations. As a result, they are not detected in most extensive monitoring or inventory efforts.

Species specific or habitat specific surveys may need to be designed to adequately sample habitat specialists in areas where they are species of concern. Open-habitat specialists include birds such as shorebirds, some upland game birds, and grassland specialists. Effective methods of counting species associated with open habitats are described in Connors (1986), Eng (1986a), and Howe (1990). Habitat specialists associated with small bodies of water include species such as hole-nesting ducks and other specialized waterfowl. These are subject to many forms of disturbance and could be valuable management indicators. Excellent methods of surveying such species are described in Eng (1986b) and Koskimies and Poysa (1991)

VI. Roles and Responsibilities

Involvement in data collection, analysis, storage, and exchange associated with the monitoring program for NTMBs extends across all levels within NFS (table 1). In particular, all levels of the agency will benefit from standardized data acquisition and data-handling methods. A scheme for assigning areas of responsibility to each level of NFS and to Research is described below.

A. Chief

The Chief should provide direction on national priorities and standards, conduct nationwide analyses, and conduct national and regional program reviews. Individual components are outlined below.

1. This document fulfills the Chief's responsibility to develop national goals, priorities, and standards for monitoring NTMBs.

2. The Chief is responsible for conducting annual reviews of the program within the NFS and Research to determine if adjustments in program direction are necessary.

3. The Chief should foster cooperative efforts with other national agencies and groups to ensure that data is appropriately entered, stored, and analyzed consistent with the goal of determining national trends in cooperative framework with other agencies and participating organizations.

4. The Chief should facilitate the distribution of data and analysis results as needed throughout the agency and share with participating organizations.

B. Regional Foresters

Regions play a major role in providing regional direction, providing services for forests, and ensuring quality work is performed within the region. The responsibilities of the regional foresters are listed below.

1. Develop a monitoring plan for each region that:

   (a) Spans a 3-year timeframe;

   (b) Meets local, regional, and national information needs;

   (c) Clearly defines and documents monitoring objectives in detail;

   (d) Establishes a bird monitoring program on every forest that accomplishes at least level 1 monitoring objectives;

   (e) Establishes a monitoring program in the region that includes all three levels of monitoring;

   (f) Clearly defines the role of the region and forests in implementing each activity associated with monitoring, including protocol development, proposal development, data collection, data entry, data analysis, and reporting; and

   (g) Is rigorously reviewed for technical soundness.

   All data collection efforts should be coordinated within and among neighboring regions, stations, and forests, including the development and implementation of project-specific sampling protocols.

2. Identify species and habitats of concern to be the focus of some or all level 2 and 3 monitoring efforts.

3. Provide the services of a regional data center that: (a) Serves as a repository for all monitoring data; (b) Provides standardized field and data entry forms and procedures; (c) Conducts data analysis and interpretation of data collected within the region; (d) Generates region-wide and special reports to meet the needs of forests, the region, the station, and the Washington Office. Data center efforts should be conducted in collaboration with Forest Service Research.

4. Provide high quality, consistent training throughout the region on data collection, data entry, and data analysis. Data analysis skills are needed at the forest and district levels to facilitate the analysis of local, specialized monitoring efforts that do not contribute to larger scale monitoring efforts.

5. Ensure that standardized methods, procedures, and training are made available for each forest.

6. Assign monitoring targets and allocate funds to forests via the forest supervisor each fiscal year as part of plan implementation.

7. Establish a regional steering committee that is comprised of representatives from forests, districts, and Forest Service Research to help develop regional direction for the bird monitoring program.

8. Adjust regional direction, standards, and guidelines in a timely fashion in response to monitoring results and trigger points. The appropriate adjustments or changes should be identified in the discussion of trigger points in each monitoring plan. Examples of potential adjustments in regional direction include:

   (a) Change management direction in the regional guide that pertains to habitats and/or ecosystems associated with bird species or groups;

   (b) Cooperate with Research in assisting forests to develop adaptive management responses to negative trends; and

   (c) Identify species or species groups that require additional protection and develop management approaches to accomplish the needed protection.

C. Forest Supervisors

National forests have an important role to play in implementing the regional monitoring plans. The responsibilities of forest supervisors will vary among regions according to the regional monitoring plans. In some regions, the regional office will take an active role in monitoring activities, whereas in others the forests will have the primary responsibility for monitoring. Potential Forest Supervisor responsibilities are listed below.

1. Develop proposals that will meet forest needs for level 2 and 3 monitoring.

2. Provide forest-wide coordination of data collection, storage, and analysis.

3. Conduct data entry and proofing.

4. For data sets that are unique to a forest, the forest will be responsible for structuring a data base format and analyzing the data through cooperation with Research.

5. Incorporate monitoring results into forest direction, particularly when monitoring data indicate that a trigger point has been reached, and a change in management is indicated.

6. Respond to concerns raised by trigger points and monitoring results by taking the appropriate action as defined in the monitoring plan. Pro-active management actions unrelated to trigger points could include: (a) Developing or altering the desired future condition, standards and guidelines, and monitoring plans in land management plans to improve habitat conditions for species of concern; and (b) Identifying NTMB species as part of a cadre of taxa to serve as indicators of biodiversity.

D. Station Directors

Participation of Research is essential to the success of the NTMB monitoring program. It is critical that NFS and Research maintain a high degree of interaction and coordination at all organizational levels. Station directors should strive to contribute to the monitoring program in the following areas.

1. Conduct studies and experiments that investigate potential causes of troublesome population trends occurring within the region.

2. Investigate the habitat relationships, productivity, and survivorship of populations of NTMBs.

3. Design and test protocols for data collection, storage, and analysis to ensure the desired quality and quantity of data are obtained.

4. Participate in regional steering committees to provide input for setting funding and research priorities, and designing monitoring schemes.

5. Assist regions in the analysis and interpretation of monitoring data whenever possible.

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VIII. Tables

Table 1. Information needs of the monitoring program for neotropical migratory birds in the USDA Forest Service.

	Administrative Level				
Information Needs	Ranger District	Supervisor's Office	Regional Office	Washington Office	Research
Inventory	x	x			
Population trends		x	x	x	x
Management impacts	x	x	x		x
Habitat associations	x	x	x		x
Habitat trends	x	x	x		

Table 2. Activities associated with each level of the agency, including Research, as a part of implementing a monitoring program for neotropical migratory birds in the USDA Forest .

	Administrative Level				
Implementation Activity	Ranger District	Supervisor's Office	Regional Office	Washington Office	Research
Study design		x	x		x
Collect data	x	x			
Enter data	x	x			
Analyze data	x	x	x		x
Training					
Field	x	x	x		
Analysis	x	x	x		x
Develop/recommend management priorities		x	x	x	x

IX. Appendices

Appendix A. Glossary

Adaptive Management
: process of implementing policy or management decisions as scientifically driven management experiments that test predictions and assumptions in management plans and policies

Biological Diversity
: the variety and relative abundance of species and biological communities over time and space, with emphasis on the synergism and uniqueness of ecosystem components

Breeding Bird Atlas
: a project to map the distribution and general abundance of breeding birds in every 10 km square grid across the face of all continents; in the U.S., the effort is usually undertaken State by State

Breeding Bird Survey (BBS)
: continent-wide, permanent roadside point counts administered by the U.S. Fish and Wildlife Service

Breeding Status
: the breeding activity of a bird

Brood Parasitism
: process by which other species of birds lay eggs in the nests of host bird species

Checklist
: a list of all bird species occurring in a location during each season

Commensal
: organisms living in close association in which one is benefitted by the relationship and the other is neither benefitted nor harmed

Counting Station
: a location of a bird count and the sample unit of most point count surveys; also referred to as "a point"

Demographic Data
: data describing the survival rates and reproductive success of a population

Desired Future Condition
: the desired resource condition for a given geographic location or landscape

Effectiveness Monitoring
: monitoring to determine if a particular action produced the expected results

Ecosystem
: a system formed by the interaction of a group of organisms and their environment

Forest Fragmentation
: conversion of a contiguous forested area into discontinuous patches, thereby reducing the total forested area, reducing patch size, and increasing isolation

Habitat Associations
: affinity of species for certain habitats

Implementation Monitoring
: monitoring to determine if a plan or project has been implemented as prescribed

Inventory
: complete survey of an area for one or more species

Management Indicator Species
: species selected for emphasis in planning and which are monitored during forest plan implementation in order to assess the effects of management actions on their populations and the populations of other species with similar habitat needs

Neotropical Migratory Birds (NTMB)
: bird species with some portion of the population breeding in temperate North America and some portion of the population wintering in the New World tropics (basically south of the U.S.)

Physiographic Provinces
: major vegetation zones of North America, based largely on Aldrich's (1963) map of life areas of North America as adopted by the Breeding Bird Survey Program

Point
: (see Counting Station)

Population Parameters
: characteristics of a population, such as productivity, survivorship, and genetic diversity

Productivity
: birth rate; reflected in this text by various indices such as adult to young ratios during the breeding season

Relevé
: a vegetation sampling technique that characterizes the plant community

Sensitive Species
: animal species for which continued viability is a concern

Sinks
: Any place where local reproduction is insufficient to balance local mortality. Populations in sinks are the result of continued immigration from other areas

Sources
: Any place where local reproduction exceeds that needed to maintain the local population. Sources produce emigrants to other areas (including sinks)

Standards and Guidelines
: management direction in the form of specified environmental requirements and/or procedural instructions that reflect minimum, maximum, or absolute acceptable conditions

Survivorship
: death rate; reflected in this text by indices such as the proportion of adults returning to the same territory in consecutive years

Transect
: In reference to point count surveys, the line along which a series of counting stations is established.

Validation Monitoring
: monitoring to determine if a model or a set of assumptions hold true in a particular area

Viable Population
: a sufficiently large population of a species such that its self-sustaining existence is assured in perpetuity throughout its range

Appendix B. Codes for Indicators of Breeding Status Established for Breeding Bird Atlases

The codes are listed in increasing certainty of breeding (from Laughlin, et al., 1990).

OBSERVED:	O	Male or female of species observed at or near a point during the breeding season, but no evidence of breeding. Not in suitable nesting habitat. Includes wide-ranging species such as vultures, raptors, and gulls or a colonially-nesting species not at the nesting colony.
POSSIBLE:	/	Male or female of species observed in suitable nesting habitat during its breeding season.
	X	One or more singing males present in suitable nesting habitat during its/their breeding season.
PROBABLE:	P	Pair (male and female) observed in suitable habitat during the species' breeding season.
	S	Singing male present at same location (in suitable habitat at suitable time for breeding) on at least 2 occasions 7 days or more apart.
	T	Individual or pair seen defending territory against conspecifics (usually by chasing or displaying).
	C	Courtship behavior or copulation seen.
	N	Bird seen visiting probable nest-site.
	A	Agitated behavior or anxiety calls from adult.
	B	Nest-building or cavity excavation by woodpeckers.
CONFIRMED:	CN	Carrying nesting material, such as sticks or other material.
	NB	Nest-building at the actual nest-site.

PE Physiological evidence of breeding obtained by an experienced bird bander on a bird in the hand (e.g., highly vascularized, edematous incubation/brood patch or egg in oviduct).

DD Distraction display or injury feigning.

UN Used nest or eggshells found, if confidently identifiable to species.

PY Precocial young, if flightless and believed close to hatching site.

FL Recently fledged young (altricial or precocial), if believed close to hatching site (poor fliers, obviously still dependent on parents, etc.).

ON Occupied nest: adults seen entering or leaving a nest. Used for situations where the eggs or young can't be seen.

CF Carrying food for young.

FY Adult feeding recently fledged young.

FS Adult carrying a fecal sac.

NE Nest with eggs.

NY Nest with young.

Notes:

1) Presence of cowbird egg or young is confirmation of cowbird and host species.

2) Knowledge of expected breeding dates helps avoid misinterpretation of observations. Recording dates of above observations helps improve knowledge of breeding dates.

3) As with all bird counting activities, training and practice improve the quality of observations.

Appendix C. Outline for Regional Monitoring Plans

Regional monitoring plans are a crucial step toward developing a detailed and coordinated monitoring effort at a national and regional scale. Regional monitoring plans should be drafted before the 1993 field season begins, and completed by the end of fiscal year 1993.

All regional monitoring plans should be reviewed within the region, and then reviewed by a panel of individuals from Research and other regional offices. The review process is simply a means of achieving a level of consistency in content, detail, and scientific validity among regions. Each panel should have at least one biometrician, two Forest Service researchers, and one biologist from another region that is also involved in developing a regional monitoring plan.

Draft regional monitoring plans should be submitted to the Washington Office by June 30, 1993. The Washington Office will submit the drafts to a panel for review. The panel members for each region will be identified by the members of the monitoring task group in collaboration with each region before June 30, 1993.

The 1993 field season should be used to prepare as much as possible for implementation of the monitoring plan in 1994 (e.g., training, setting up point count transects for level 1 monitoring, pilot implementation to test monitoring designs and estimate sample size requirements).

An outline for the regional monitoring plan is provided below. Each section addresses required inclusions, optional inclusions, and comments. Each section should be described in as much detail as possible.

I. Background

Required: Discuss the current status of monitoring and inventory activities for birds occurring in the region and what relationship they will have to the activities described in the monitoring plan.

II. Monitoring Goals

Required: Describe broad monitoring goals for the region that reflect national monitoring goals for each region, as well as the region's unique opportunities to contribute to national monitoring goals. Goals should also reflect the region's goals and opportunities for obtaining local, regional, and national information. The goals of each region should be based upon (but not limited to) the items listed below.

1. Incorporate the ideas, suggestions, and standards addressed in the monitoring task group report.

2. Approach the suggested balance of activities, as described in the monitoring needs assessment (Butcher 1992):

   (a) 50 percent of all monitoring should encompass all habitat types and all bird species;

   (b) 25 percent of monitoring efforts should be allocated to rare habitat types and rare bird species; and

   (c) 25 percent of monitoring efforts should be allocated to studies of reproductive and survival rates.

3. Consider the balance of activities across each season (breeding, winter, and migration).

4. Consider how to mesh new monitoring activities with existing monitoring (e.g., BBS, land management plan monitoring) and existing or needed inventory activities.

5. Consider how to structure NTMB monitoring to best meet existing monitoring needs as described in land management plans and other existing plans that are not yet being implemented.

III. Define Objectives and Hypotheses

Required: Define objectives for monitoring that will accomplish the monitoring goals for the region. Objectives should be clear statements that express the desire or need for specific types of information to be obtained over a given period of time. The objectives should also clearly reflect items 1-4 listed in the goals section above. Once the objectives are clearly defined, the details for implementation need to be described for each objective.

For each objective, one or more null hypotheses should be clearly stated, which, if investigated through monitoring efforts, would meet the monitoring objective and move us forward in our understanding and management of NTMBs. For example, if the objective is to track population trends of three target NTMB species, the region must still decide: (1) Over what period of time trends are to be tracked; (2) If it is important to know the species is increasing, decreasing, or both; and (3) At what scale trends need to be tracked. For example, the region may be interested in calculating year to year variation over a 3-year period and needs to know if the species declined by 10 percent or more between years on three specific forests. The null hypothesis for each species would then be: no population declines over 10 percent between years occurred across these three Forests.

Comment: Seek out a good reference that discusses hypothesis testing and experimental design for use in this and subsequent sections of the monitoring plan. Some good references for hypothesis testing and sampling design include Goldsmith (1991), Green (1979), Krebs (1989), McNab (1983), Ralph and Scott (1981), Sokal and Rohlf (1981), and Spellerberg (1991). For additional references, seek the advice of researchers at a research station in your area.

IV. Describe Methods and Experimental Design for Each Hypothesis

Required: Describe what information is needed to prove or disprove each null hypothesis. The information needed will dictate the method(s) and experimental design to be used. Methods and experimental design descriptions need to be as detailed as possible. Questions that span multiple forests or regions should have methods spelled out in detail so they can be implemented consistently throughout the region. The level of detailed habitat data to be collected and what protocols to be used should also be addressed for questions that span multiple forests or regions. Questions that are unique to a forest may not need to be determined in the regional plan, but can be left to the forest to work out locally. However, whenever possible, use standard protocols as a basis for protocols to facilitate the comparison of results across geographic areas. If existing protocols are not adequate and new protocols are untested, field test the new protocol before attempting to implement it throughout the region.

V. Define Trigger Points for Each Hypothesis

Required: The information collected to test each hypothesis should have clearly defined response variables (i.e., variables for which trigger points are defined), clearly defined, quantified values for each trigger point, and a clearly defined response (e.g., some type of direct intervention, a specific change in land management, designation of species as sensitive) for each trigger point. Each monitoring hypothesis being tested should have multiple trigger points identified that identify various levels of concern and the appropriate management responses.

Plans should state that the response variables being monitored and their associated trigger points should be evaluated on a semiannual basis to determine: (1) If they track parameters of importance; (2) If the trigger values are set at the correct levels; and (3) If the management response is appropriate. Trigger points for regional monitoring objectives should be described in the regional monitoring plan. Trigger points for monitoring efforts occurring at a smaller scale should be described in the regional monitoring plan if possible or documented in monitoring proposals as they are developed by the forests.

VI. Data Center Services

Required: Each plan must outline how the region will provide the services of a data center, as described in the roles and responsibilities for regions, that will: (a) Serve as a repository for all monitoring data; (b) Provide standardized field and data entry forms and procedures; (c) Conduct data analysis and interpretation of data collected within the region; and (d) Generate region-wide and special reports to meet the needs of forests, the region, the station, and the Washington Office.

Comment: A number of options are available to regions, including a cooperative venture with Research, a cooperative venture with other entities in the Partners in Flight group in one or more States, or handing the responsibilities within the regional office. A cooperative venture with Research in some capacity is advised, as most regional offices will not have the time, expertise, and/or stability over time required to provide the service required to make a data center fully functional.

VII. Develop an Implementation Schedule

Required: Each plan should cover projected activities for 3 years. The implementation schedule should describe how, when, and where (by forest or region) activities will occur, including training, data collection, and data analysis. In addition, the schedule should contain a projected budget for approximate costs for each year.

Optional: Plans may be made more flexible by taking a hierarchical approach to implementation. Regions could establish a hierarchy of monitoring efforts which defines a baseline of efforts and then additional activities to be undertaken with specified increases in funding. The regional monitoring plan should tier to the 5-year action plan developed by the region for the NTMB program. If the monitoring plan is constructed in a hierarchical fashion, then the lowest level of effort described in the monitoring plan should approximate the projected level of funding for monitoring in the 5 year action plan.

Comment: The purpose of this section is for the region to document what will be required to achieve the goals and objectives and to make sure the objectives and implementation schedule are achievable given expected levels of funding. It will also help the forests understand exactly what is required to accomplish the monitoring as described. Most likely, regions and forests will need to have a phased implementation of the monitoring plan to allow time for training, for internal support to grow, and for adjustments in the monitoring scheme.

VIII. Plan Updates

Required: The final section should describe how the plan will be updated. The regional monitoring plan for NTMBs should reflect the best known approach to designing, collecting, analyzing, interpreting, and responding to monitoring data. As new information becomes available, the document should be updated to reflect changes in our understanding of NTMBs, the roles they play in our ecosystems, and the appropriate and most effective management actions to take to conserve the species. Plans should be updated every 1 to 2 years, using the analysis of monitoring data from previous years and advances in the understanding of the species as the basis for changes in the plan.

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